Comparison of friction and wear of articular cartilage on different length scales

The exceptional tribological properties of articular cartilage are still far from being fully understood. Articular cartilage is able to withstand high loads and provide exceptionally low friction. Although the regeneration abilities of the tissue are very limited, it can last for many decades. These biomechanical properties are realized by an interplay of different lubrication and wear protection mechanisms. The deterioration of cartilage due to aging or injury leads to the development of osteoarthritis. A current treatment strategy focuses on supplementing the intra-articular fluid with a saline solution containing hyaluronic acid. In the work presented here, we investigated how changing the lubricating fluid affects friction and wear of articular cartilage, focusing on the boundary and mixed lubrication as well as interstitial fluid pressurization mechanisms. Different length and time scales were probed by atomic force microscopy, tribology and profilometry. We compared aqueous solutions with different NaCl concentrations to a viscosupplement containing hyaluronic acid (HA). In particular, we found that the presence of ions changes the frictional behavior and the wear resistance. In contrast, hyaluronic acid showed no significant impact on the friction.
coefficient, but considerably reduced wear. This study confirms the previous notion that friction and wear are not necessarily correlated in articular cartilage tribology and that the main role of HA might be to provide wear protection for the articular surface. (C) 2015 Elsevier Ltd. All rights reserved.

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